

# **How Should Tehachapi Wind be Interconnected to Grid**

2004 IEPR Transmission Update

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## **Underlying Factors – Tehachapi Total Potential Resource**

- Quality of the Wind Resource
- Land Use Issues = Is the Land Available for Wind
- Cost Effectiveness Issues

## **The Tehachapi Wind Resource is Excellent and Reliable**

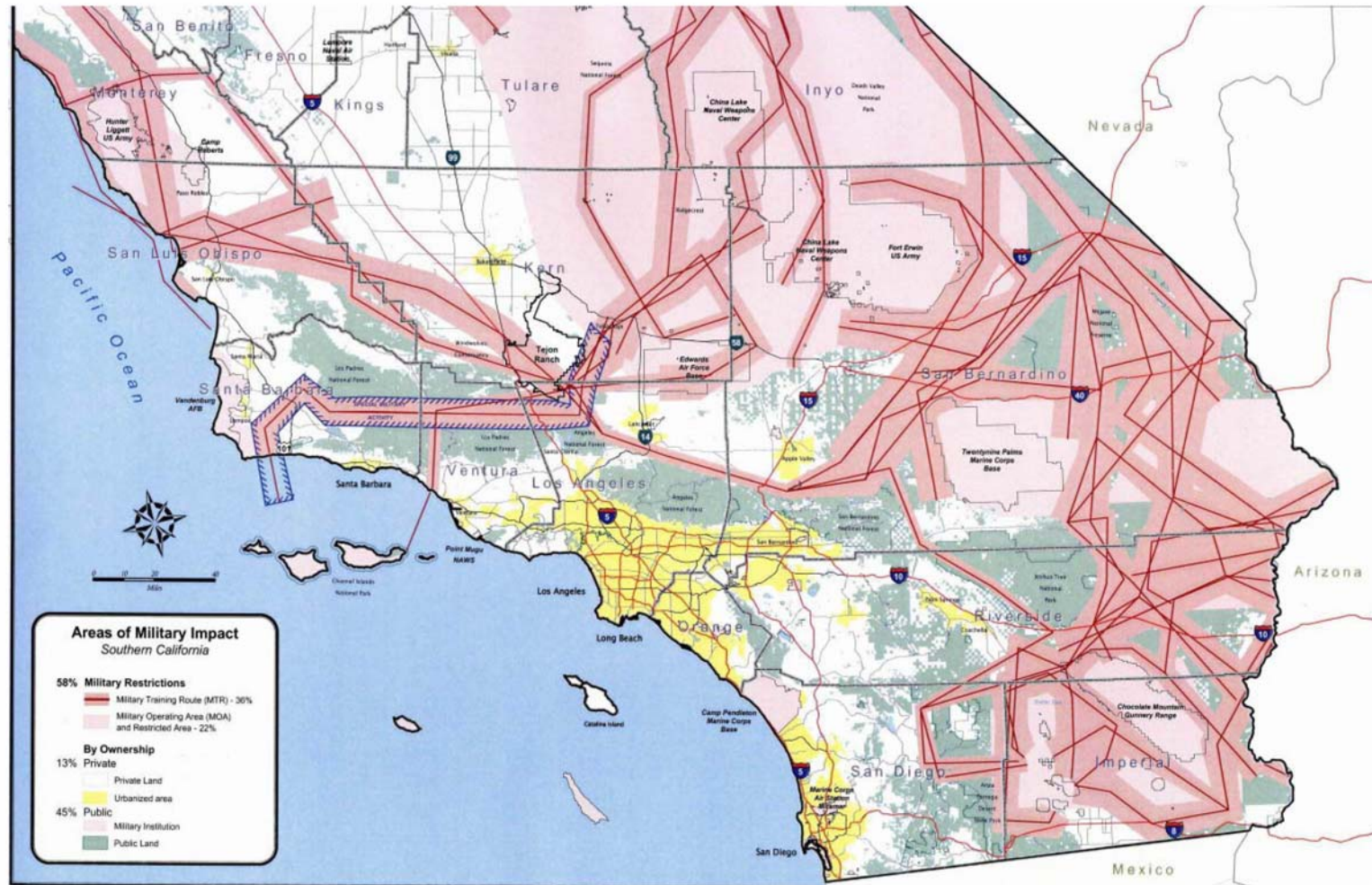
- Resource is Driven by Reliable Forces
  - Hot Desert pulls Cold Ocean Air
  - Amplified by Jet Stream & Weather Patterns
- Early Recognition of Potential; Potential Remains Strong
  - Over 20 Years Operation
  - 670 MW Operating Across Area
- Most of the Good Land is Available for Wind Energy
  - Little Encroachment
  - Positive Public and Governmental Environment

## Land Use Planning is Advanced

- Land Use Planning Specific for Wind Energy  
Master Environmental Assessment in Place  
Wind Energy Zoning Overlay
- Military Interference Issues Nearing Consensus  
Interim Ordinance in Place  
Permanent Ordinance Anticipated Soon
- Negligible Environmental Impact Issues  
Impacts have been Feasible to Avoid or Mitigate

Figure: Resource to Support Major MW is  
Identified and Planned – not for distribution

# Military Low Level Flight Routes = Interference Factor



# Modern Wind Turbines Reach into Low Level Military Routes

			Tip Height											
		Tower												
Rotor Diameter		Meters	39.6	40.0	42.7	45.0	50.0	55.0	65.0	70.0	72.0	80.0	100.0	120.0
Meters	Feet	Feet	130.0	131.2	140.0	147.6	164.0	180.4	213.3	229.7	236.2	262.5	328.1	393.7
27.0	88.6		174.3	175.5	184.3	191.9	208.3	224.7	257.6	274.0	280.5	306.8	372.4	438.0
39.0	128.0		194.0	195.2	204.0	211.6	228.0	244.4	277.3	293.7	300.2	326.5	392.1	457.7
44.0	144.4		202.2	203.4	212.2	219.8	236.2	252.6	285.5	301.9	308.4	334.7	400.3	465.9
47.0	154.2		207.1	208.3	217.1	224.7	241.1	257.5	290.4	306.8	313.3	339.6	405.2	470.8
48.0	157.5		208.8	210.0	218.8	226.4	242.8	259.2	292.1	308.5	315.0	341.3	406.9	472.5
50.0	164.0		212.0	213.2	222.0	229.6	246.0	262.4	295.3	311.7	318.2	344.5	410.1	475.7
52.0	170.6		215.3	216.5	225.3	232.9	249.3	265.7	298.6	315.0	321.5	347.8	413.4	479.0
54.0	177.2		218.6	219.8	228.6	236.2	252.6	269.0	301.9	318.3	324.8	351.1	416.7	482.3
62.0	203.4					249.3	265.7	282.1	315.0	331.4	337.9	364.2	429.8	495.4
64.0	210.0					252.6	269.0	285.4	318.3	334.7	341.2	367.5	433.1	498.7
70.5	231.3						279.7	296.1	329.0	345.4	351.9	378.2	443.8	509.4
72.0	236.2						282.1	298.5	331.4	347.8	354.3	380.6	446.2	511.8
77.0	252.6							306.7	339.6	356.0	362.5	388.8	454.4	520.0
80.0	262.5							311.7	344.6	361.0	367.5	393.8	459.4	525.0
82.0	269.0							314.9	347.8	364.2	370.7	397.0	462.6	528.2
87.0	285.4								356.0	372.4	378.9	405.2	470.8	536.4
90.0	295.3								361.0	377.4	383.9	410.2	475.8	541.4
92.0	301.8								364.2	380.6	387.1	413.4	479.0	544.6
94.0	308.4								367.5	383.9	390.4	416.7	482.3	547.9
104.0	341.2									400.3	406.8	433.1	498.7	564.3
110.0	360.9										416.7	443.0	508.6	574.2
120.0	393.7											459.4	525.0	590.6

Figure: Cooperative Mutual Planning Can  
Resolve Issues – not for distribution



## What is the Tehachapi Plausible Wind Energy Resource? Including Antelope Valley Area

- One Can Find Over 5,000 MW of Developable Good Wind Resource in Eastern Kern County
- Existing MEA Area, Planned PEIR Area Likely to have Over 4,000 MW of Developable Good Winds
- Assumes Efficient Development of Land
- Assumes Orderly Development over 5 Plus Years
- Ultimate Potential of Area is Greater, Assuming Military Interference is Resolved in Key Areas

## Cost Effectiveness Continues to Improve

- Substantial Prime, Proven Resource
- Extensive Good, Proven Resource
- Newer Turbines More Cost Effective in Good Winds
- Cost of Capital is Dropping with Industry Track Record
- Increased Competition for Tax Benefits Lowers Cost
- Increased Experience = Lower Risk

## **Physical Limits on Existing Transmission Substantial Transmission Right Here...But...**

- 66 KV Legacy Grid
- 230 KV Sagebrush Line, Privately Owned
- 230 KV LADWP Owens Gorge – Rinaldi Line
- 500 KV DC Pacific Intertie, Path 65
- 230 KV Big Creek Corridor (10-15 Miles Away)
- 500 KV Path 26 (10-15 Miles Away)

Figure: Substantial Transmission Right  
Here...But... -- not for distribution

## 66 KV Legacy Grid

### SCE Owns...States There is No Added Capacity

- Probably Has Some Capacity, but Very Small to Need  
Generation Planned at Measured KW, Not Nameplate
- SCE Planning CAISO Approved Minor Upgrade
- Poor Maintenance Condition = Periodic Failures
- Exposed To: Fire, Lightning, Vehicle Damage
- Better Transmission Needed;
- Conventional Criteria Does Not Justify as Evaluated
- Area Under Served: Served Load; Renewable Generators

**230 KV Sagebrush Private QF Line**  
**Ownership Structure has Restricted Use of Capacity**  
**Vincent – Antelope – Near New #1 & #2 & #3**

- Ownership Structure Consolidating
- Financing Covenants Expiring, Line 15 Years Old
- Line is Very Successful, Reliable
- 320 MW Installed and Operating
- Apparently 60 MW Additional to Come On Line Soon
- Line was Rated approximately 400 MW
- Line may be Rated approximately 625 MW
- Full Utilization of Such a Line, if 2 Circuited is 1,400 MW

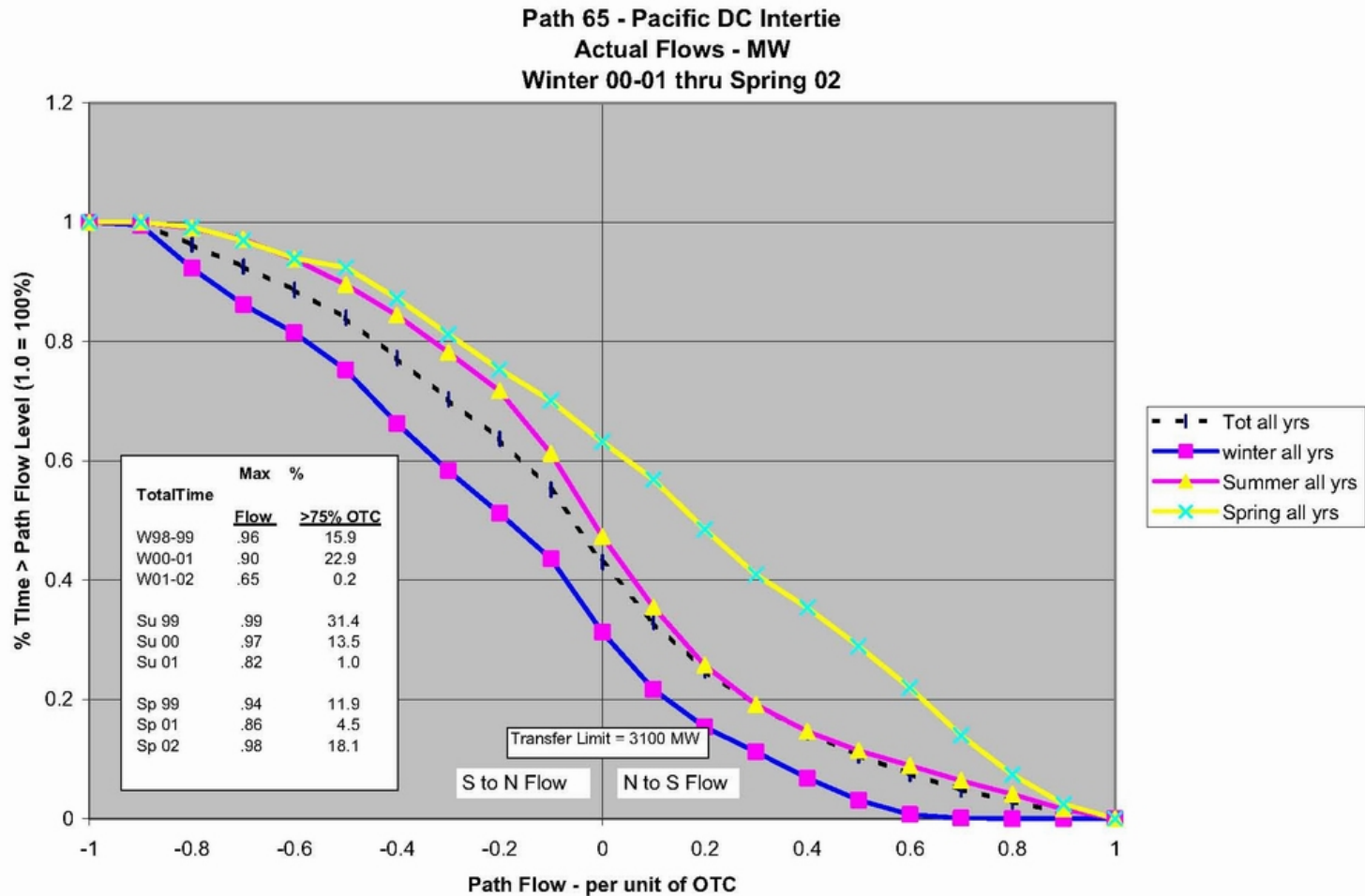
## 230 KV Owens Gorge – Rinaldi Line Owned and Operated by LADWP

- Line May Have 270 MW Capacity Available
  - Core Use of Line May Be Intermittent Hydro
  - 120 MW Pine Tree Project in Environmental Review
  - 150 MW Added Project Rumored
- 
- Line & Right of Way Appears to be Valuable, Attractive
  - LADWP is not Part of CAISO Grid
  - Histogram Line Loading Data Not Available

# 500 KV DC Pacific Intertie: Path 65

## In Same Corridor as Owens Gorge – Rinaldi Line

### Available Capacity Unclear





230 KV Big Creek Corridor

10 to 15 Miles Away

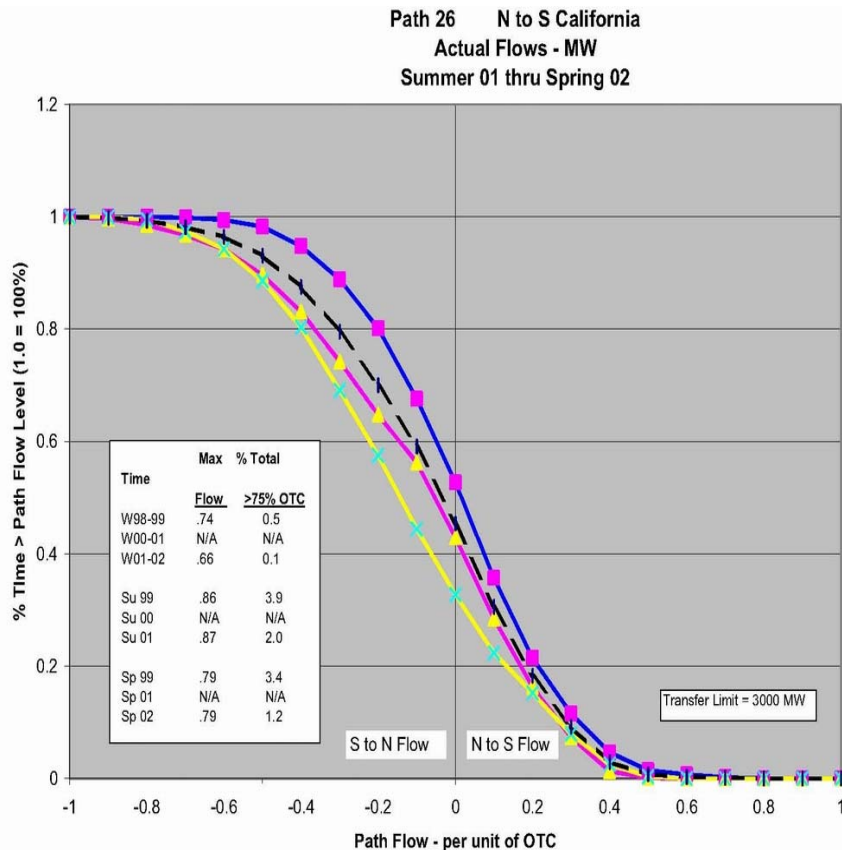
Also: At Magunden & Crossed North to Midway

- CAISO Has Identified Interfaces with PG&E
  - Off Load at Helms to Increase Pumped Storage
  - Off Load at Helms Also Capacity for Fresno
  - Off Load at Magunden for Link to Bakersfield
- Line is Ancient = Needs Reconductoring?
- Capacity or Reconductor Potential Unknown
- CAISO Identified 600 MW Potential from Off Loading
- Route May Be Useful for Northerly Path Parallel Path 26

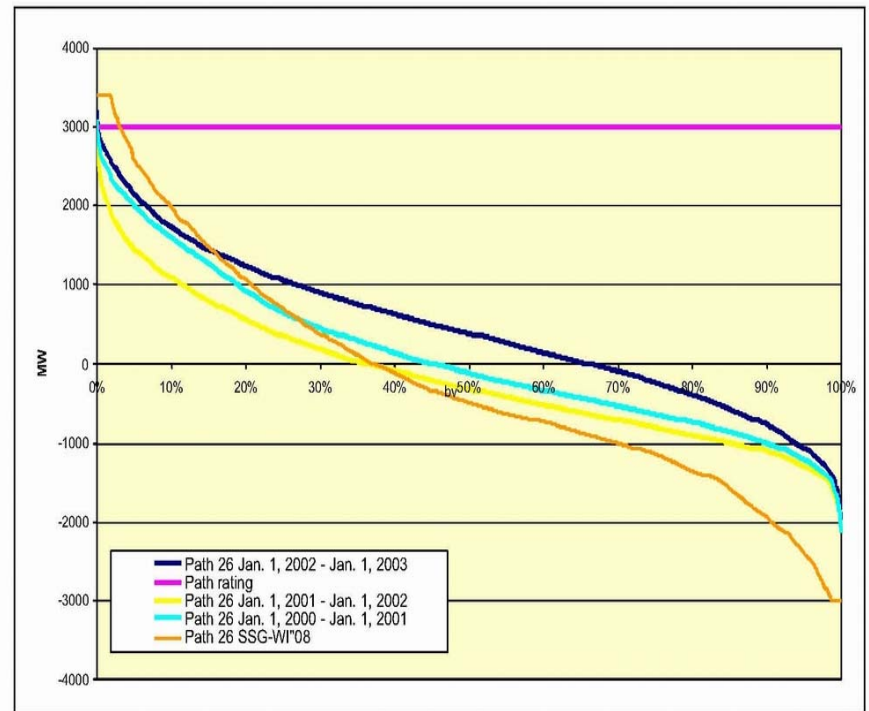
# 500 KV Vincent – Midway Line: Path 26

## 10 to 15 Miles Away

### Available Capacity Unclear; Need for Additional Line?



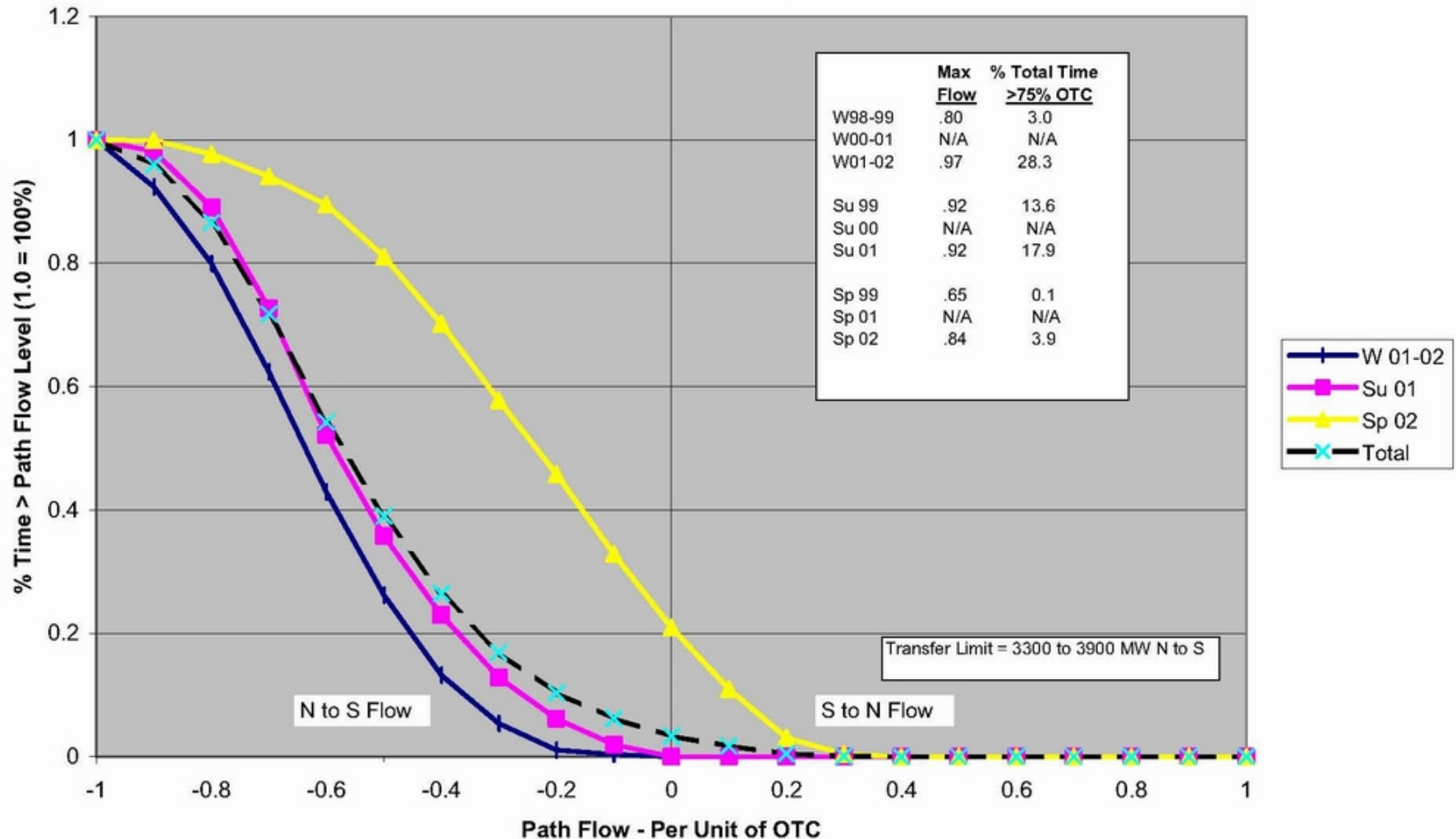
## Path 26



# 500 KV Midway North = Path 15

## Path Clearly Has Substantial Capacity North to PG&E

Path 15 Midway - Los Banos  
Actual Flows - MW  
Summer 01 thru Spring 02



## How Should the Resource Be Connected? Without Further Delay...

- Resource is So Large that Expedient Solution Reasonable
- Do a First Step Quickly; Optimize Further Steps
- Pardee to Antelope to Tehachapi #1 = Many Benefits Now
- Pardee to Antelope Opens Vincent for Orderly Expansion
- Vincent Corridor is Land Locked = Need Relief to Expand
- Sagebrush Line Could Play Role
- Significant PEA Done...Take Advantage of Work Done...
- Tehachapi Needs Reliability of a Better System

Reliability Issue is Not Line Loading, Its Inherent

Figure: A Number of Alternative Choices for  
Integration – not for distribution

Effective Integration Might Involve...  
But Start a Reasonable First Step Quickly...Now...

- Integration with Big Creek
- Integration with Path 26
- Integration with Sagebrush
- Integration with Owens Gorge – Rinaldi
- Integration with Pacific Intertie = Path 65
- Effective Use of Existing, Adjacent, Rights of Way
- Such Can be Orderly Planned, Such as in CPUC-CAISO  
STEP Type Planning

## Near Term Likely Technologies Should Impact Final Choices

- Effective Use of Distributed Dynamic VARs (wtg VARs)
  - Dynamic Ratings of Conductors
  - Integrated Energy Storage
  - Efficient Use of Dynamic Curtailment
  - Advanced Conductors with Increased Current Carry
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- A Core Effective System is First Need; Above Enhances...
  - These Technologies Provide Incremental Improvement